Defense Modeling & Simulation Office

Linking Simulations Through Common Data

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Overview

- The Nature of the Problem
  - Basic Definitions
  - Hierarchical Abstraction
  - Simulation Focus

- Data Issues for Linking Simulations
  - Composable Solutions Strategy
  - Recognition
  - Realization
  - Repeatability
  - Reuse

Basic Definitions

- **DATA**

  Delineation of facts, parameters, values, concepts, or instructions in a formalized manner suitable for communications, interpretation, or processing by humans or by automatic means.

- **MODEL**

  A physical, mathematical, or otherwise logical delineation of a system, entity, phenomenon, or process.

- **REPRESENTATION**

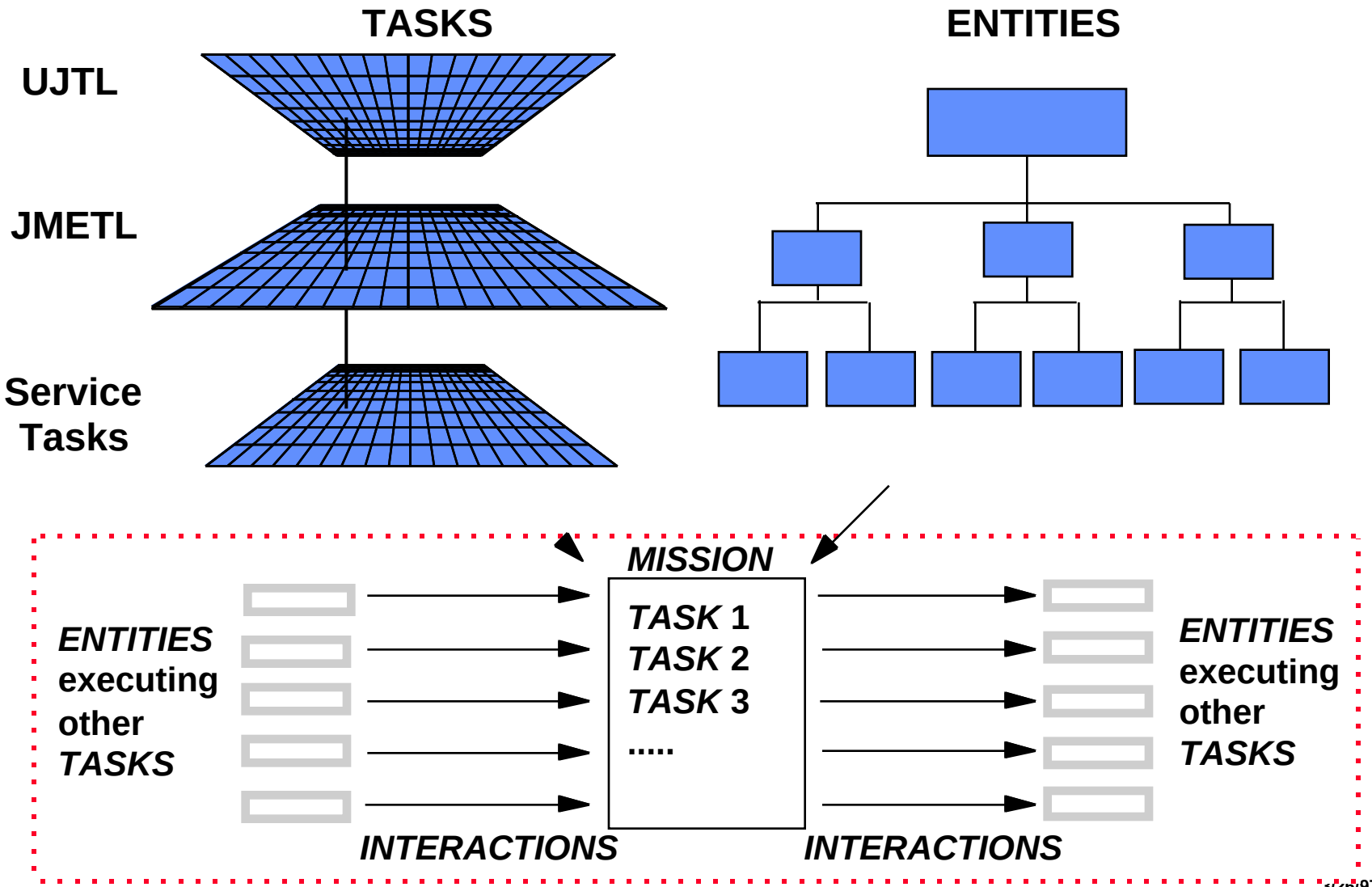
  The combination of a MODEL, process, or algorithm and the associated DATA, parameters, or values. Traditional implementations sharply separate algorithms and values. Contemporary implementations join MODEL and DATA as an object.

"Messages which resolve ambiguity are information. All other messages are noise." [Shannon], Therefore:

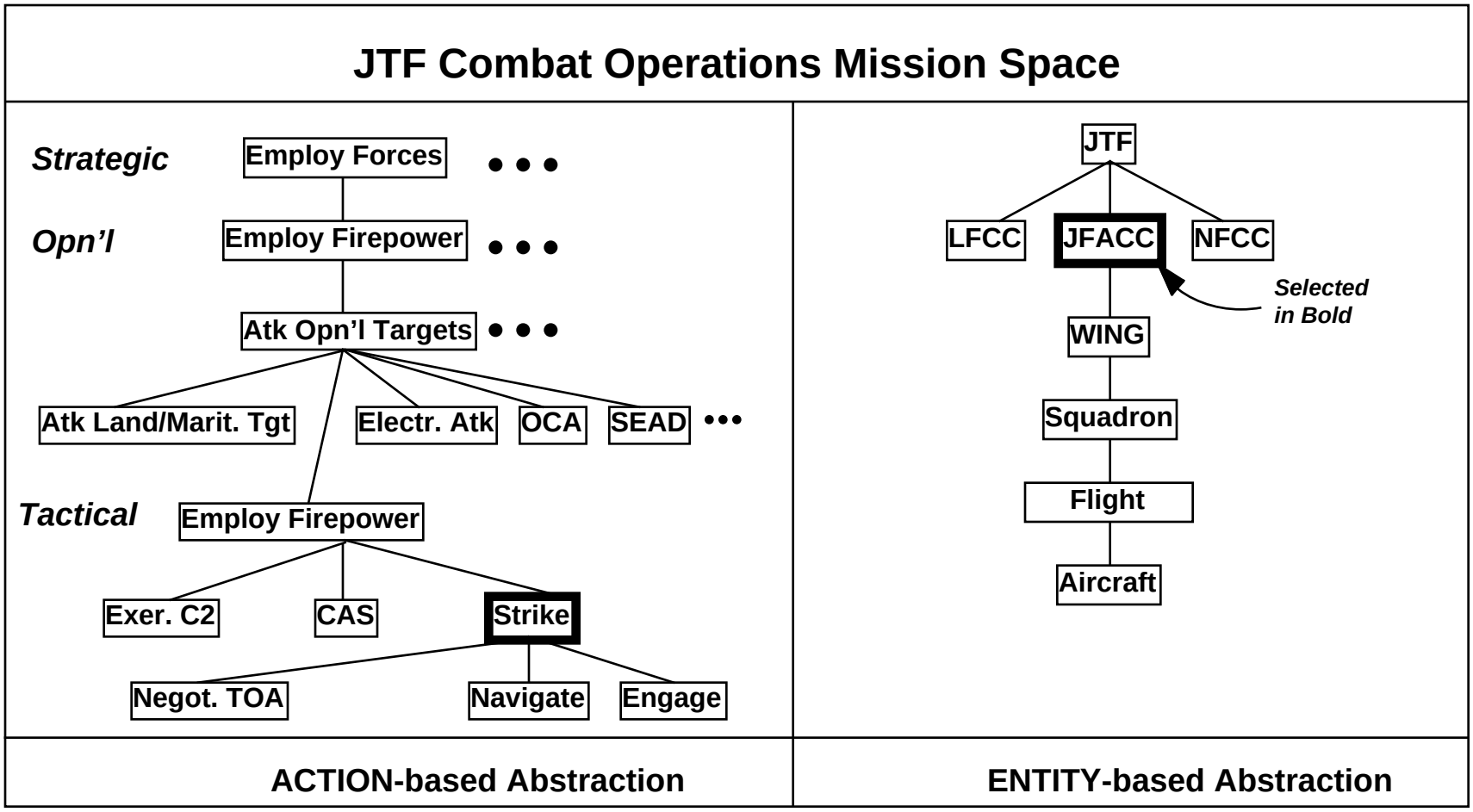
- **INFORMATION**

  DATA in context related to a specific purpose

Hierarchical Nature of Military Operations



Operations with Operations, Systems of Systems



Example

Consider an F/A-18 allocated to a deep penetration interdiction mission

- **the details which are included or excluded**
- **the resolution, granularity, and aggregation of information**

for the real warfighter in actual military operations are very different if that warfighter is:

- **a general officer in the National Command Authority**
- **the wing commander in the air operations center**
- **the flight leader in the strike package, or**
- **the pilot of the F/A-18**

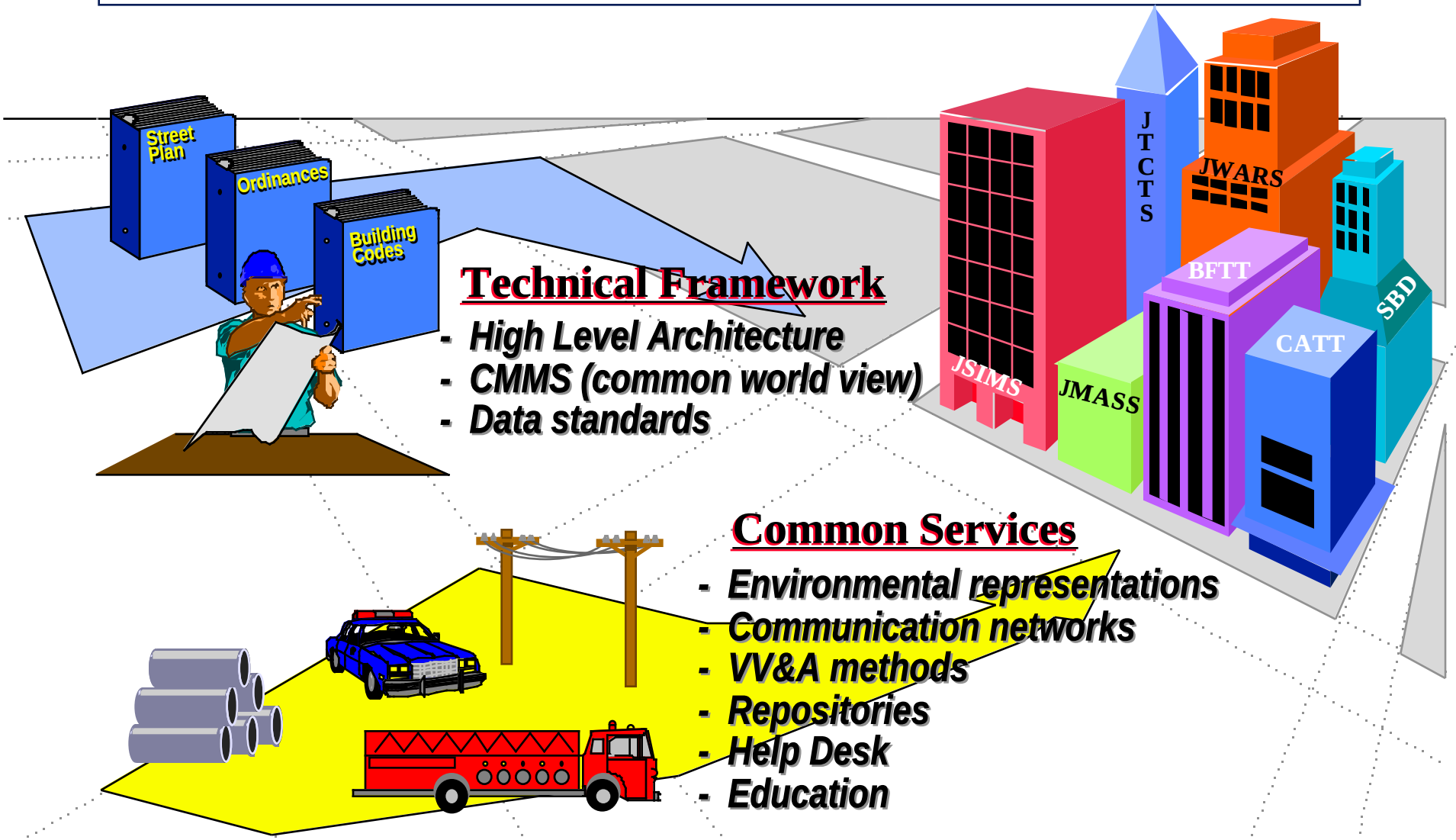
Every Simulation has a Focus

- **Entities/Actions Near the Focus are REPRESENTED with**
  - **Fine-Grained Decomposition**
  - **Extensive Detail**
  - **High Fidelity**

- **Entities/Actions Distant from the Focus are REPRESENTED with**
  - **Coarse-Grained Decomposition**
  - **Limited Detail**
  - **Lower Fidelity**

- **The DATA required to Link REPRESENTATIONS between Simulations depends upon**
  - **the Location of the real Entity/Action in the Hierarchy and**
  - **the Focus of the Simulation**

DoD M&S Strategy:
An Analogy to City Planning



Payoffs: Interoperability and reuse = capability and cost-effectiveness

Composable Solutions Strategy

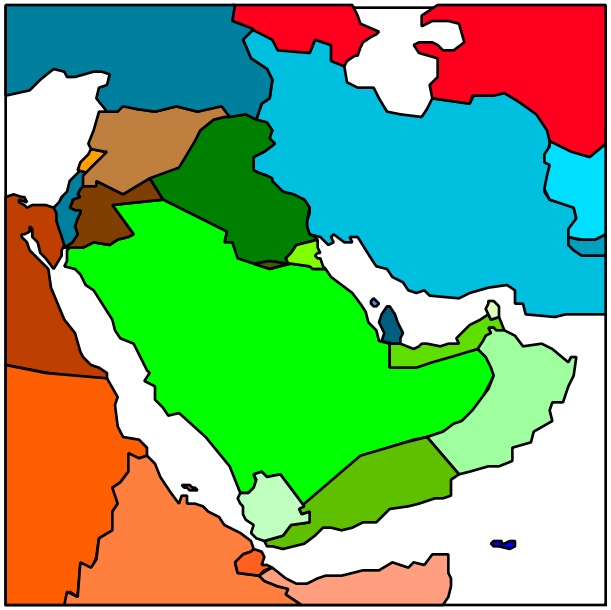
- **Traditional M&S product development follows a top-down process:**
  - **requirements are derived from specific operational needs**
  - **designs are derived from the requirements, and**
  - **custom components are created to implement the design**

- **While providing individually excellent products, this approach leads to**
  - **limited interoperability and re-use between independently conceived products**
  - **significant time and resource investment to adapt tochanging requirements**
- **The composable M&S solutions strategy employs the principal of design inversion where:**
  - **requirements are derived from specific operational needs**
  - **families of standard components are retained in a repository, and**
  - **specific designs are created to meet the requirements using existing components in the repository**

Data Issues for Linking Simulations

Data Issue:		Simulation Linkage Approach:
Recognition	→	Common Semantics and Syntax
Realization	→	Data Creation Sequence
Repeatability	→	Data Engineering Process
Reuse	→	Authoritative Data Sources Data Interchange Formats

Common Syntax and Semantics



CSS is the vehicle for:

- **recognizing content**
- **repeatable construction**

which <u>enables</u> re-use.

Order of Battle CSS:

- **same meaning, different terms**
  - **CFDB country codes**
  - **MIDB alligiance**
- **same term, different meaning**
- **common task organization template**

Separate Mission Space CSS from Information Systems CSS

- **Layer-0: CSS for General Purpose IS Templates**
  - **Level-0** Unstructured Text, Freeform Diagrams
  - **Level-1** IDEF0 Activity Model, IDEF1X E-R Diagram, Op-Spec
  - **Level-2** Use-Case, Process, Behavior Diagrams (Core, Statemate, RDD)
  - **Level-3** Booch, Rumbaugh, Schler-Mellor, UML, IDEF Object, ...
- **Layer-1: CSS for Structure and Content Specific to the Mission Space**
  - **Level-0** Flat Lexicon (Joint Publications series)
  - **Level-1** Global Namespace Data Dictionary (Core C2 data model)
  - **Level-2** Hierarchical Semantics with Recursive Elements (CMMS EATI)
  - **Level-3** Multiple-Inheritance Data Elements
- **Layer-2: CASE Tool-Specific Style Guides**
  - **Level-0** Tool Features to Include/Exclude
  - **Level-1** Tool Feature Usage Conventions
  - **Level-2** Model Structure and Layout Conventions

ENTITY-Based Abstractions

- **ENTITY** A distinguishable person, place, thing, or concept about which information is kept [2]. In particular, *ENTITY* includes the notions of person, organization, facility, feature, materiel, and plan defined in [5].

- Concrete Examples
  - Person — Wing Commander, Pilot
  - Organization — JFACC, Flight
  - Facility — Airbase, Power Plant
  - Feature — Road, River, Bridge
  - Materiel — F15, AWACS, Sidewinder
  - Plan — ATO

- Abstraction Examples
  - Core C2 — GCCS entity-relationship diagram
  - JWSOL — JTF-ATD object classes

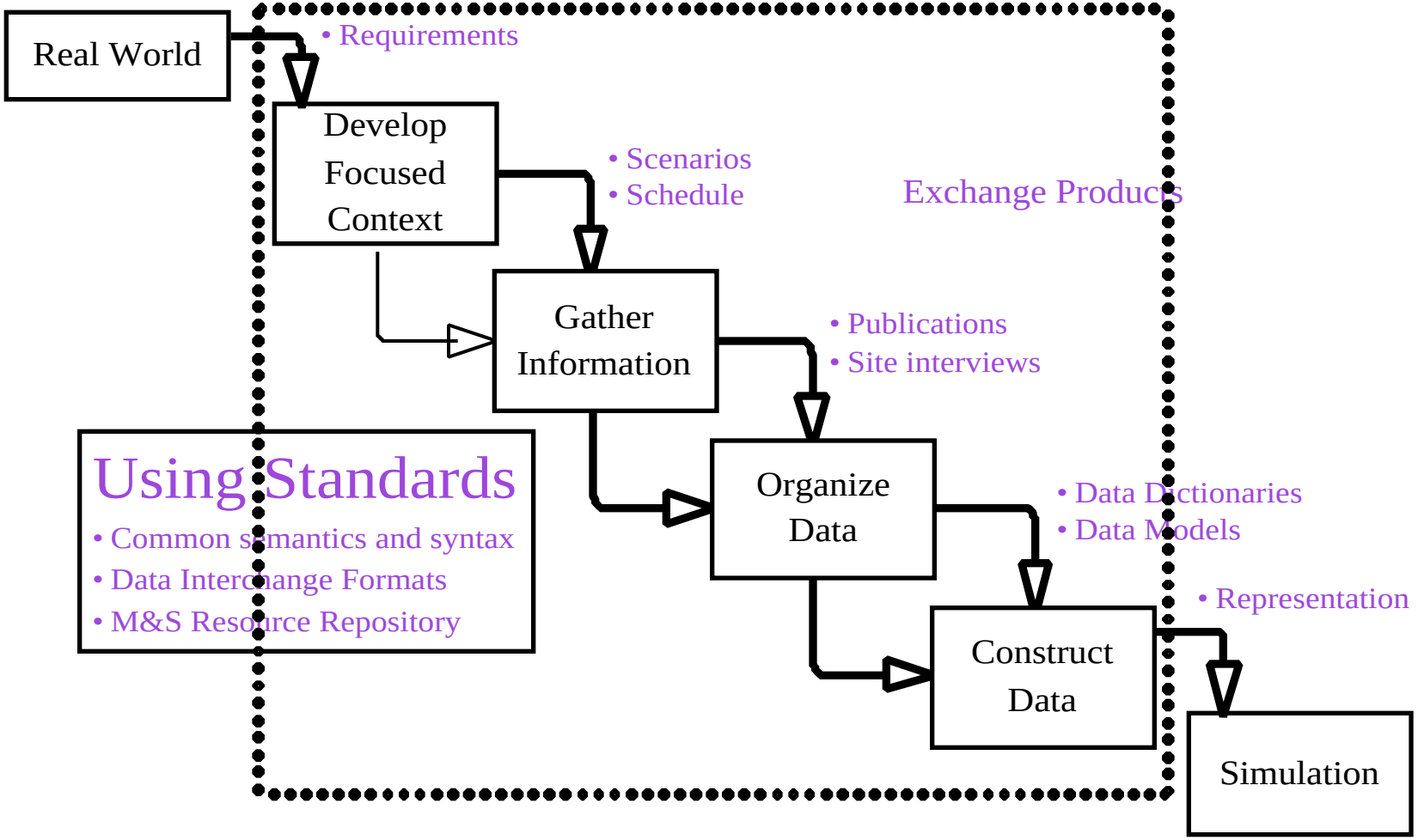
ACTION-Based Abstractions

- **ACTION** The alteration or transformation by natural force or human agency which produces a change in state or condition. *ACTION = VERB* [+ *ENTITY*]

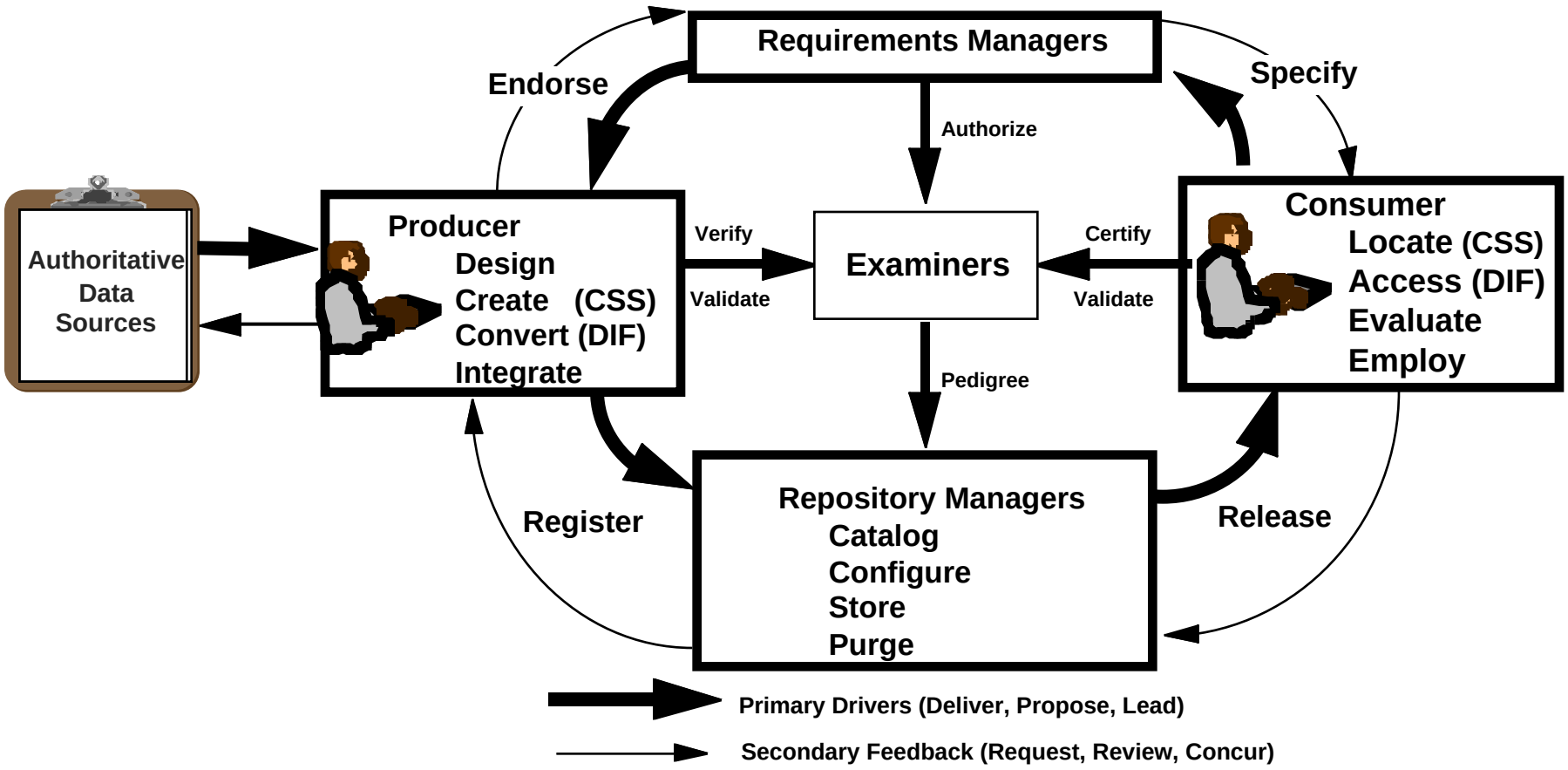
- **Concrete Examples**
  - **Physical Verbs** Move, Sense, Communicate, Engage, Replenish,...
  - **Cognitive Verbs** Develop, Monitor, Analyze, Supervise,...
  - **Capabilities** Refuel Aircraft
Launch Missile
Detect Submarine
Generate ATO

- **Abstraction Examples**
  - **UJTL** Process-oriented operations templates
  - **CMMS Verb Syntax** Behavior-oriented C2 templates

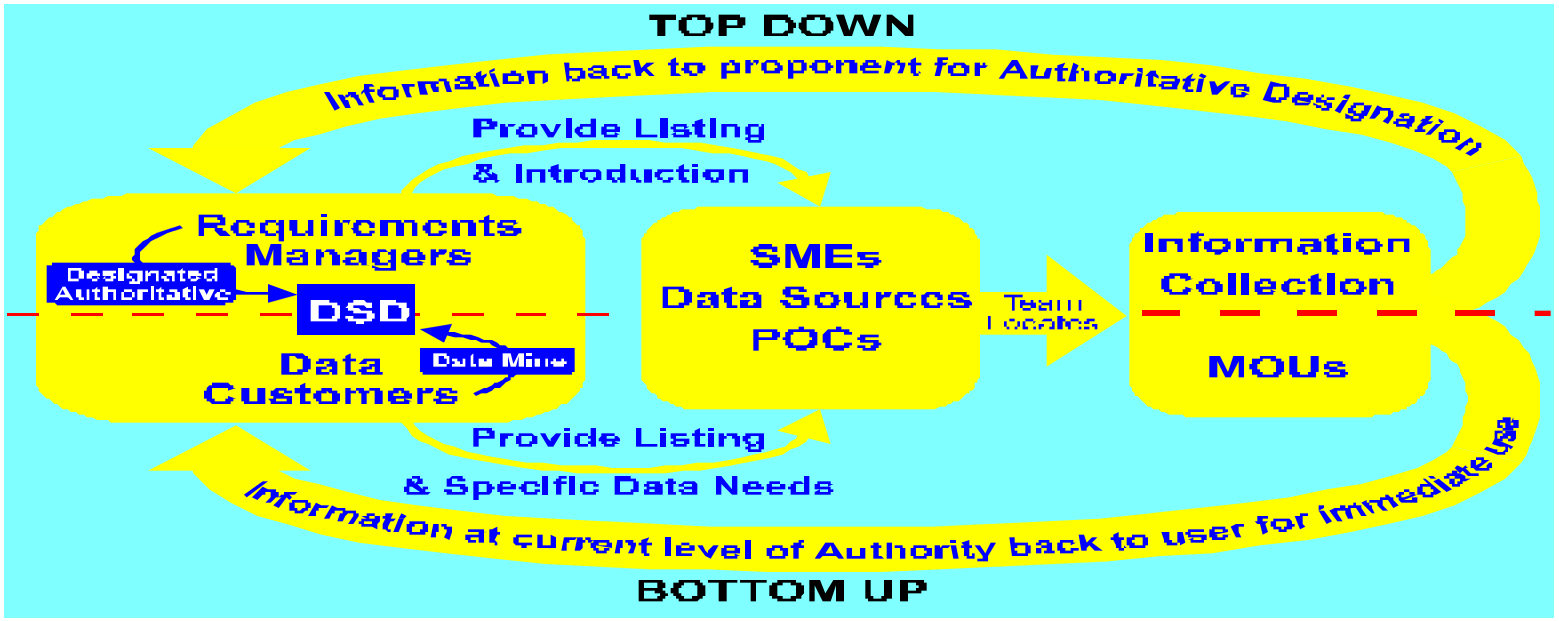
Data Creation Sequence



Data Engineering Process ver 0.1.4



Authoritative Data Sources (ADS)



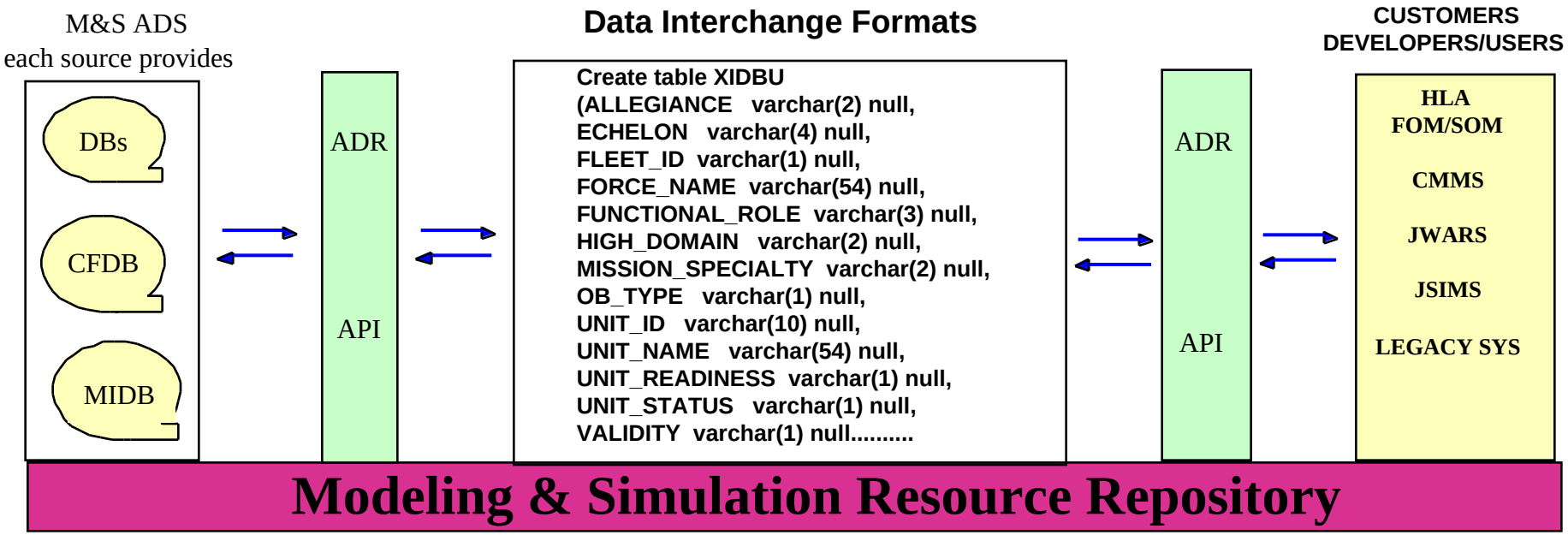
- **ADS consists of the:**
  - **the Producer**
  - **the Data**
  - **the Pedigree**
- **<u>AND</u> designation by an Authority.**

These Order of Battle ADS's:

- **JOPES, Service's Personnel & Logistics DBs**
- **CENTCOM CFDB**
- **DIA MIDB**

will be available in the DMSO demo

Data Interchange Formats (DIF)



DIF is the physical realization of the logical CSS structure and content:

- **logical specification**
- **physical format**
- **families of interfaces**

used by programmers to exchange data.

Order of Battle examples:

- **US & IRAQ unit OB descriptions**
- **Scenario Generation**
- **OB file formats**

will be available in the DMSO demo